PCT/IB03/ 2806/521831

Sertifikaat

PATENTKANTOOR

REPUBLIC OF SOUTH AFRICA

DEPARTEMENT VAN HANDEL
EN NYWERHEID

Certificate

PATENT OFFICE

REPUBLIEK VAN SUID-AFRIKA

Rec'd PCT/PTO 21 JAN 2005

DEPARTMENT OF TRADE AND
INDUSTRY

Hiermee word gesertifiseer dat
This is to certify that

REC'D 12 SEP 2003
WIPO PCT

the documents attached hereto are true copies of the Forms P2, P6, provisional specification and drawings of South African Patent Application No. 2002/9237 in the name of Sasol Wax (SA) (PTY) LTD

Filed	:	13 November 2002
Entitled	:	Polymeric Fibre Extrusion

Geteken te / Signed at PRETORIA in die Republiek van Suid-Afrika, hierdie / in the Republic of South Africa, this **6th** dag van / day of **August 2003**

Registrateur van Patente

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

FORM P.2

REPUBLIC OF SOUTH AFRICA	REGISTER OF PATENTS	PATENTS ACT, 1978

OFFICIAL APPLICATION			LODGING DATE: PROVISIONAL		ACCEPTANCE DATE	
21	01	2002/9237	22	13 NOV 2002	47	
INTERNATIONAL CLASSIFICATION			LODGING DATE: COMPLETE		GRANTED DATE	
51			23			

FULL NAME(S) OF APPLICANT(S)/PATENTEE(S)

71 ~~SCHUMANN SASOL SOUTH AFRICA (PROPRIETARY) LIMITED~~ VERANDER CHANGED

SASOL WAX (SA) (PTY) LTD 10.3.08

APPLICANTS SUBSTITUTED:		DATE REGISTERED
71		

ASSIGNEE(S)		DATE REGISTERED
71		

FULL NAME(S) OF INVENTOR(S)

72
1. BENETTI, ALDO
2. FOURIE, JOHAN
3. ZWANE, IVOR MZWANDILE

PRIORITY CLAIMED	COUNTRY		NUMBER		DATE	
N.B. Use International abbreviation for country (see Schedule 4)	33	NIL	31	NIL	32	NIL

TITLE OF INVENTION

54 POLYMERIC FIBRE EXTRUSION

ADDRESS OF APPLICANT(S)/PATENTEE(S)

1 KLASIE HAVENGA ROAD, SASOLBURG, 1947, FREE STATE, SOUTH AFRICA

ADDRESS FOR SERVICE		S & F REF
74	SPOOR & FISHER, SANDTON	PA133791/P

PATENT OF ADDITION NO.		DATE OF ANY CHANGE
61		
FRESH APPLICATION BASED ON		DATE OF ANY CHANGE

SPOOR & FISHER

REPUBLIC OF SOUTH AFRICA REVENUE

FORM P.1

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT

AND ACKNOWLEDGEMENT OF RECEIPT
(Section 30 (1) – Regulation 22)

02.11.02

R 0060.00

HASR 711
INKOMSTE
REPUBLIEK VAN SUID AFRIKA

The granting of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

OFFICIAL APPLICATION NO. | S & F REFERENCE

21	01	2002/9237

PA133791/P

FULL NAME(S) OF APPLICANT(S)

71	~~SCHUMANN-SASOL SOUTH AFRICA (PROPRIETARY) LIMITED~~ SASOL WAX (SA) (PTY) LTD

NAME CHANGED 10.05.02

ADDRESS(ES) OF APPLICANT(S)

1 KLASIE HAVENGA ROAD, SASOLBURG, 1947, FREE STATE, SOUTH AFRICA

TITLE OF INVENTION

54	POLYMERIC FIBRE EXTRUSION

THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2. THE EARLIEST PRIORITY CLAIM IS:

COUNTRY: NIL NUMBER: NIL DATE: NIL

~~THIS APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO.~~

21	01	

~~THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 37 AND IS BASED ON APPLICATION NO.~~

21	01	

THIS APPLICATION IS ACCOMPANIED BY:

- ☒ 1. A single copy of a provisional specification of 6 pages.
- ☐ 2. Drawings of sheets
- ☐ 3. Publication particulars and abstract (Form P.8 in duplicate).
- ☐ 4. A copy of Figure of the drawings (if any) for the abstract.
- ☐ 5. Assignment of invention.
- ☐ 6. Certified priority document.
- ☐ 7. Translation of the priority document.
- ☐ 8. Assignment of priority rights.
- ☐ 9. A copy of the Form P.2 and the specification of S.A. Patent Application No .
- ☐ 10. Declaration and power of attorney on Form P.3.
- ☐ 11. Request for ante-dating on Form P.4.
- ☐ 12. Request for classification on Form P.9.
- ☒ 13. Form P.2 in duplicate.
- ☐ 14. Other.

74	ADDRESS FOR SERVICE: SPOOR & FISHER, SANDTON

Dated: 13 November 2002

SPOOR & FISHER
PATENT ATTORNEYS FOR THE APPLICANT(S)

REGISTRAR OF PATENTS DESIGNS, TRADE MARKS AND COPYRIGHT
RECEIVED
2002 -11- 13
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

REGISTRAR OF PATENTS

SPOOR & FISHER

FORM P.6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) – Regulation 27)

OFFICIAL APPLICATION NO.			LODGING DATE	
21	01		22	13 NOVEMBER 2002

FULL NAMES OF APPLICANTS

71	~~SCHUMANN-SASOL SOUTH AFRICA (PROPRIETARY) LIMITED~~ NAAM VERANDER NAME CHANGED 10·03·03 SASOL WAX (SA) (PTY) LTD

FULL NAMES OF INVENTORS

72	BENETTI, ALDO FOURIE, JOHAN ZWANE, IVOR MZWANDILE

TITLE OF INVENTION

54	POLYMERIC FIBRE EXTRUSION

BACKGROUND OF THE INVENTION

THIS invention relates to polymeric fibre extrusion.

Synthetic filaments and fibres are usually produced via an extrusion process whereby the polymer (*e.g.*, polypropylene, polyethylene, polyester, nylon, *etc.*) is melted and forced through fine holes known as spinnerets. The fibres are then stretched or drawn until the required weight (or denier) is achieved.

2002/9237

The drawing process involves a continuous stretching of the solid polymer fibre of filament at a temperature slightly below its melt temperature and is used to align long polymer molecules in the fibre- or filament drawing direction which gives the fibre- or filament its strength. The degree of stretching (described by the draw ratio) determines the fibre strength (tenacity) and ultimate elongation properties. The production of fine fibres or filaments requires a polymer which:

(i) has a low enough viscosity in the melt that it can be extruded through the fine spinnerets at a sufficiently high rate without the onset of draw resonance or melt fracture; and,

(ii) has a high enough molecular weight that the mechanical strength of the fibres or filaments are sufficient to prevent breakages during drawing. Furthermore, the properties of the fibre or filament need to meet the requirements of the final application.

Unfortunately the polymer requirements for good processability do not result in good final properties, and *vice versa*. Processing of low molecular weight polymers results in weak fibres or filaments at best, but low molecular weight are usually not processable at commercially important extrusion outputs due to filament breakages and often result in die build-up and dripping. While better property fibres and filaments are produced using higher molecular weight polymers, this comes at a cost during processing when high torques are required to extrude the more viscous melt. This may be overcome somewhat by processing at higher temperatures, however this results in thermal degradation of both the polymer (which leads to decreased mechanical properties) and additives or adjuvant substances such as pigments mixed with the polymer. The use of high torques leads to high power consumption of the extruder, which also contributes to the cost of fibre or filament production.

SUMMARY OF THE INVENTION

According to the invention there is provided a method for extruding a polymer, typically for producing polymeric filaments and fibres from a polymer, the method including the steps of:

1. adding a linear low-molecular weight polymer, to the polymer being processed; and
2. extruding the mixture so formed.

The linear low-molecular weight polymer typically has a chain length of C30 to C1000, preferably C80 to C120.

From 0.5% to 25% w/w preferably from 1% to 4% w/w linear low-molecular weight polymer may be added to the polymer to be processed.

The linear low-molecular weight polymer may be melt blended or simply mixed with the polymer to be processed prior to the extrusion step.

The invention also relates to an extruded polymeric product containing from 0.5% to 25% w/w preferably from 1% to 4% w/w linear low-molecular weight polymer having a chain length from C30 to C1000, typically from C80 to C120. Advantageously, the low-molecular weight polymer is a wax produced in the Fischer-Tropsch process

DESCRIPTION OF EMBODIMENTS

This invention relates to a improved method for the production of polymeric fibres or filaments in an extrusion process. Typical polymers that may be processed are polypropylene (homopolymer and copolymer), polyethylene (low density, linear low density and high density) as well as blends thereof.

According to the invention, a linear low-molecular weight polymer is added to the polymer being processed prior to the extrusion process.

Typical low-molecular weight polymers include linear polymethylene with very little branching (preferably <5 CH3/1000C). Chain lengths of C30 to C1000 are suitable although chain lengths of C80 to C120 are preferred. Particularly suitable linear low-molecular weight polymers are waxes which are produced in the Fischer-Tropsch process.

The amount of low-molecular weight polymer which is added to the polymer to be processed depends on the solubility of the low-molecular weight polymer in the polymer to be processed. Usually the low molecular weight polymer will be added in the amount of between 0.5% to 25% w/w, preferably 1% to 4% w/w.

In one embodiment, a method according to the invention is carried out by mixing a polymer to be processed with a linear low-molecular weight polymer as described above. The mixture is then fed to an extruder which is operated at temperatures of between 110°C – 300°C, depending on the polymer run, typically 110°C - 200°C for LDPE and LLDPE, 130°C – 220°C for HDPE and 170°C - 280°C for PP. The actual temperature profile used as well as the melt temperature of the polymer depends on the linear density of the tape being produced, the processing equipment and the converter preferences. The melted polymer is extruded either as a sheet or as tapes or as monofilaments into either a chilled water bath (water temperature typically 5°C - 30°C) or onto a chilled roller. The extruded fibre is then heated through an annealing oven or over a hot-plate, the temperature of which depends on the polymer run, as well as the line speed, but is typically set about 80°C – 100°C (LDPE and LLDPE), 100°C - 130°C (HDPE) and 110°C - 150°C (PP). Draw ratios between 1:2 and 1:12 may be used, although typical ratios of between 1:4 and 1:8 provide the best balance of properties (tenacity and elongation).

The presence of the low molecular weight polymer in the polymer to be processed acts as a viscosity modifier during processing. The use of this viscosity modifier results in the following:

(i) lower torques than otherwise required to extrude a polymer with the same molecular weight and molecular weight distribution characteristics at the same melt temperature. The polymer therefore experiences less shear during processing and is less degraded resulting in stronger fibres and filaments with a superior balance of properties;

(ii) lower extruder torque is reflected as lower electrical power requirements. This may be enjoyed as a cost saving or, in the case where the extruder is running at capacity the use of the invention allows for increased outputs becoming possible by using the additional power available from the easier processing to increase the screw speed;

(iii) the easier processability of polymer with the same molecular weight also means the polymer can be processed at a lower temperature without higher motor torques being necessary. Lower temperatures result in less thermal degradation and are required when temperature sensitive pigments are used; and reduce the levels of smoking or fuming of volatile products or degradation by-products;

(iv) lower processing temperatures also result in a reduced fibre- or filament-cooling requirement. The rapid cooling (quenching) of the molten fibres extruded from the spinnarets is an important control parameter in the production of fibres and filaments, poor or slow cooling results in a more crystalline fibre or filament which cannot easily be drawn without breaking;

(v) the reduction of melt viscosity when using the invention described also mean that a higher molecular weight polymer can be processed without higher demands on the extruder motor than when running a lower molecular weight polymer without the addition of the described invention;

(vi) although there are a number of variables which effect fibre- or filament strength, as a general rule-of-thumb tenacity and elongation are inversely proportional to one another at draw ratios of commercial interest. Obtaining a high tenacity at a low draw ratios will result in tapes with good ultimate-elongation properties. The addition of the described invention acts as a solid-state viscosity modifier at the temperatures used for drawing. This results in easier drawing and higher tenacities are attained at lower draw ratios with a consequence that higher ultimate-elongation properties are achieved;

(vii) the ability to produce high tenacity fibres- or filaments at lower draw ratios benefits converters with equipment limited in the draw ratios possible. It also allows for power savings during drawing;

(viii) the addition of the described invention running the same draw ratio will result in higher tenacity and ultimate-elongation fibres or filaments being produced than using the same base polymer under the same process conditions without the addition of the invention up to the point where the fibre or filament is overdrawn; and

(ix) the addition of the described invention also allows converters to run heavier (higher denier) fibres and filaments at outputs not readily achievable without the addition of the invention.

Dated this 13TH day of November 2002.

Spoor & Fisher
Applicants Patent Attorneys